Mission Requirements

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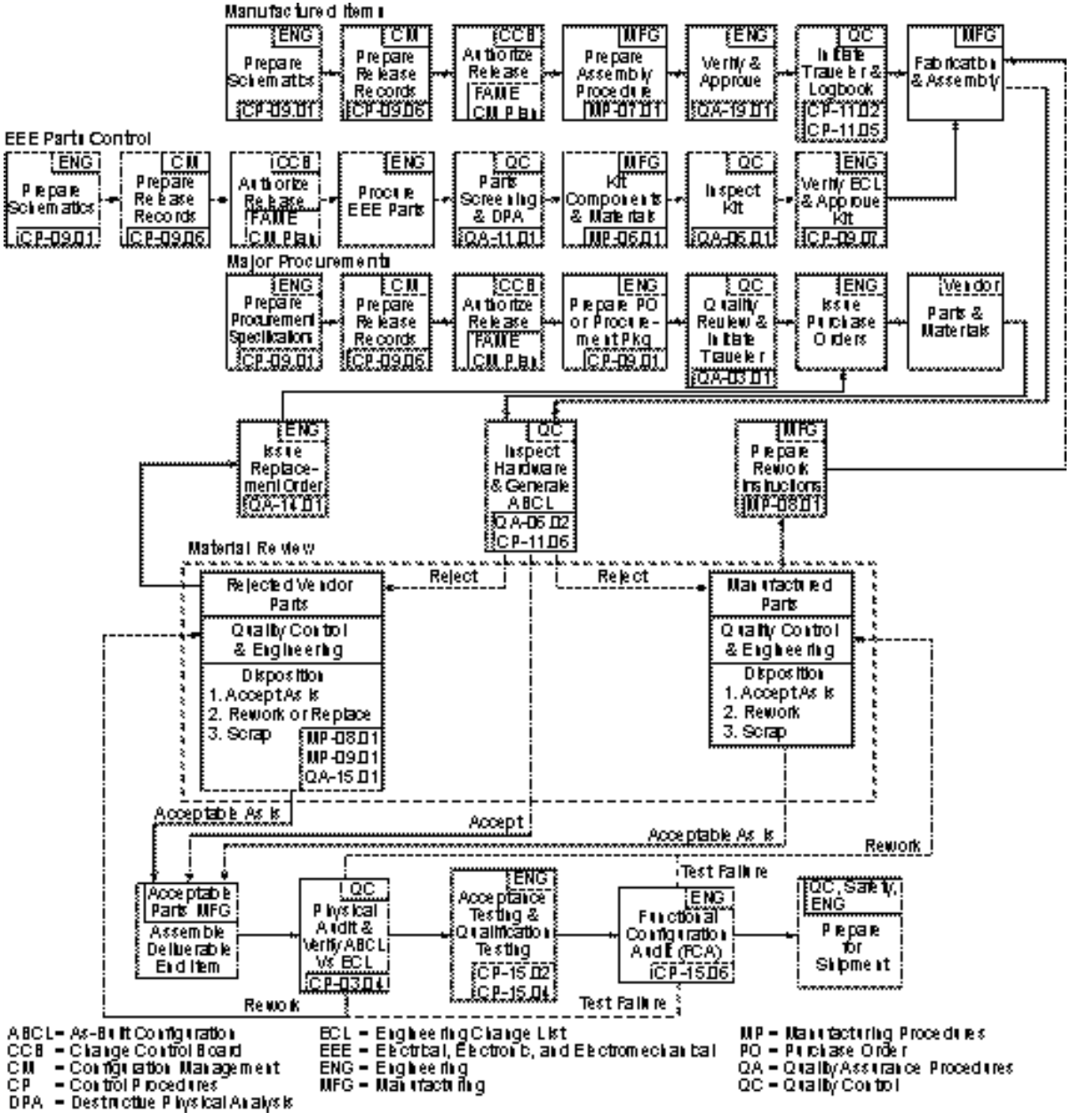
Flight Assurance Requirements (1 of 9)

- Quality System
  - Quality Assurance Plan (QAP) Based On Guidelines of ANSI/ASQC Q9001-1994
  - Includes Workmanship, Personnel Training, Non-Conformance Control, Procurement Control, Metrology, Configuration Management, Contamination Control, and QA Records
  - Documented in FAME Product Assurance Plan NCST-D-FM005
- Workmanship
  - Employ Guidelines of NASA, Commercial and/or Military Standards
    - Soldering: ANSI/J-STD-001
    - Cable, Harness, and Wiring: NHB 5300.4 (3G)
    - Crimping: NHB 5300.4 (3H)
    - Conformal Coating and Staking: NHB 5300 (3J)
    - Printed Wiring Board Design: IPC-D-275
    - ESD Control: EIA-625
  - Printed Wiring Board Coupons Tested by GSFC Prior to Assembly of Circuit Cards

QA Program Flow



Flight Assurance Requirements (2 of 9)

- Failure Reporting
  - Failure Review and Corrective Action System (FRACAS) Beginning at Acceptance Testing
    - Includes Discrepancy Reports for Hardware and Software
  - Failure Review Board (FRB) Chaired by the FAME Program Manager
- Reviews
  - System Requirements Review (SRR)
  - Preliminary Design Review (PDR) (End of Phase B)
  - Confirmation Review (CONR) (End of Phase B)
    - Briefing to NASA
  - Critical Design Review (CDR) (End of Phase C)
  - Pre-Environmental Review (PER) (Phase C/D)
    - Also Called Test Readiness Review (TRR)
  - Pre-Ship Review (PSR) (Phase C/D)
  - Flight Readiness Review (FRR) (Phase C/D)
- NASA Plans to Have Red Teams at Most of Our Reviews

Flight Assurance Requirements (3 of 9)

- System Safety Program
  - Identify and Control Hazards to Personnel, Facilities, Support Equipment, and Flight System During All Stages of Development
  - Meet Requirements of EWRR 127-1
  - Procedures
    - Develop and Submit Ground Operations Procedures
    - Identify and Highlight Hazardous Procedures
    - Comply With Applicable Launch Site Safety Regulations
  - Safety Data Package
    - Submit at Each Phase C/D Review, Up to and Including PSR
    - Include Detailed Description of Payload Design, Hazard Analysis Method, and Other Applicable Safety Related Information
    - Include Hazardous/Toxic Materials and Associated MSDs
  - Launch Site Safety Plan – As Required by Launch Site

Flight Assurance Requirements (4 of 9)

- **Design Assurance**
  - **Parts**
    - **EEE Parts Selected, Specified, Screened, and Qualified per GSFC 311-INST-001 Rev A, Quality Level 2 or Better**
    - **Develop and Maintain EEE Parts Identification List**
  - **Materials and Processes**
    - **Implement Materials and Processes Program at Beginning of Phase B**
    - **Proposed Materials and Processes Documented and Available at PDR**
    - **Maintain List of Items and Appropriate Usage Records**
    - **TML <1% and CVCM <0.1%**
    - **MRD Identifies Requirements for Structural, Metallic, Magnetic, Finishes, and Stress Corrosion**

Flight Assurance Requirements (5 of 9)

- **Bonding/Grounding**
  - **Use MIL-B-5087 As a Guideline**
  - **All Metallic Hardware Electrically Grounded to Spacecraft**
    - **Metal to Metal Impedance of 2.5 Milliohms or Less (Box to Deck)**
    - **Metal to Composite Impedance of 10 Ohms or Less**
  - **Primary Power Returns Only Grounded at Spacecraft Single Point Ground**
    - **Primary Power Isolated From Secondary Power Returns by a Minimum of 1 Megohm**
    - **No Power Returned Through Spacecraft Structure**
  - **All MLI Metal Surfaces Grounded to Metallic Structure With a DC Resistance of 50 Ohms or Less**

Flight Assurance Requirements (6 of 9)

- **Reliability Analysis**
  - **Worst Case Analysis of All New Circuit Designs**
  - **FMEA for Interfaces (All Rather Than Just Between S/C and Instrument)**
  - **Fault Tree Analysis (by NASA Request)**
  - **Reliability Predictions**
    - **No Minimum Reliability Number Specified**
    - **System Designed to Operate for 5 Years in FAME Orbit**
    - **Minimize Single Point Failures Within Cost and Schedule Constraints**

Flight Assurance Requirements (7 of 9)

- **Software**
  - **Code Produced Shall Be Structured, Verified to Minimize Errors, and Maintainable**
  - **All Software Under CM at Initial Capability Build**
  - **S/W Development Plan (SDP)**
  - **S/W Requirements Specification (SRS)**
    - **Includes the CSCI Requirements, I/O Interfaces, Design Description, and Source Code**
  - **S/W Test Plan (STP)**
    - **Includes Test Methodology for the CSCI and Any External Equipment/Simulations Necessary for Testing**
  - **Software IV&V May Be Required**

Flight Assurance Requirements (8 of 9)

- **Verification Program**
  - **Ensure That the Spacecraft and Instrument Meet Specified Mission Requirements**
  - **Provide Verification Documentation, Including:**
    - **Verification Matrix**
    - **Environmental Test Matrix**
    - **Verification Procedures**
    - **Test Procedures**

Flight Assurance Requirements (9 of 9)

- **Contamination, Control, and Cleanliness (NCST-D-FM007)**
  - **Identify Contamination-Sensitive Surfaces and the Effects of Contamination on the Mission Objectives and Performance Goals**
  - **Assess Performance Degradation as a Function of Contamination Accumulations**
  - **Determine Acceptable Degradation Levels**
  - **Translate Levels into Deposition Levels**
  - **Design Contamination Control Program Which Ensures Allowable Contamination Levels Will Be Met for Each Mission Phase**
    - **Fabrication, Assembly, I&T, Transportation and Storage, Launch, etc.**
  - **Evaluate and Identify Materials Selection, Clean-Room Equipment, Personnel Requirements, Hardware Cleaning, Monitoring, Vacuum Bake-Out, etc.**

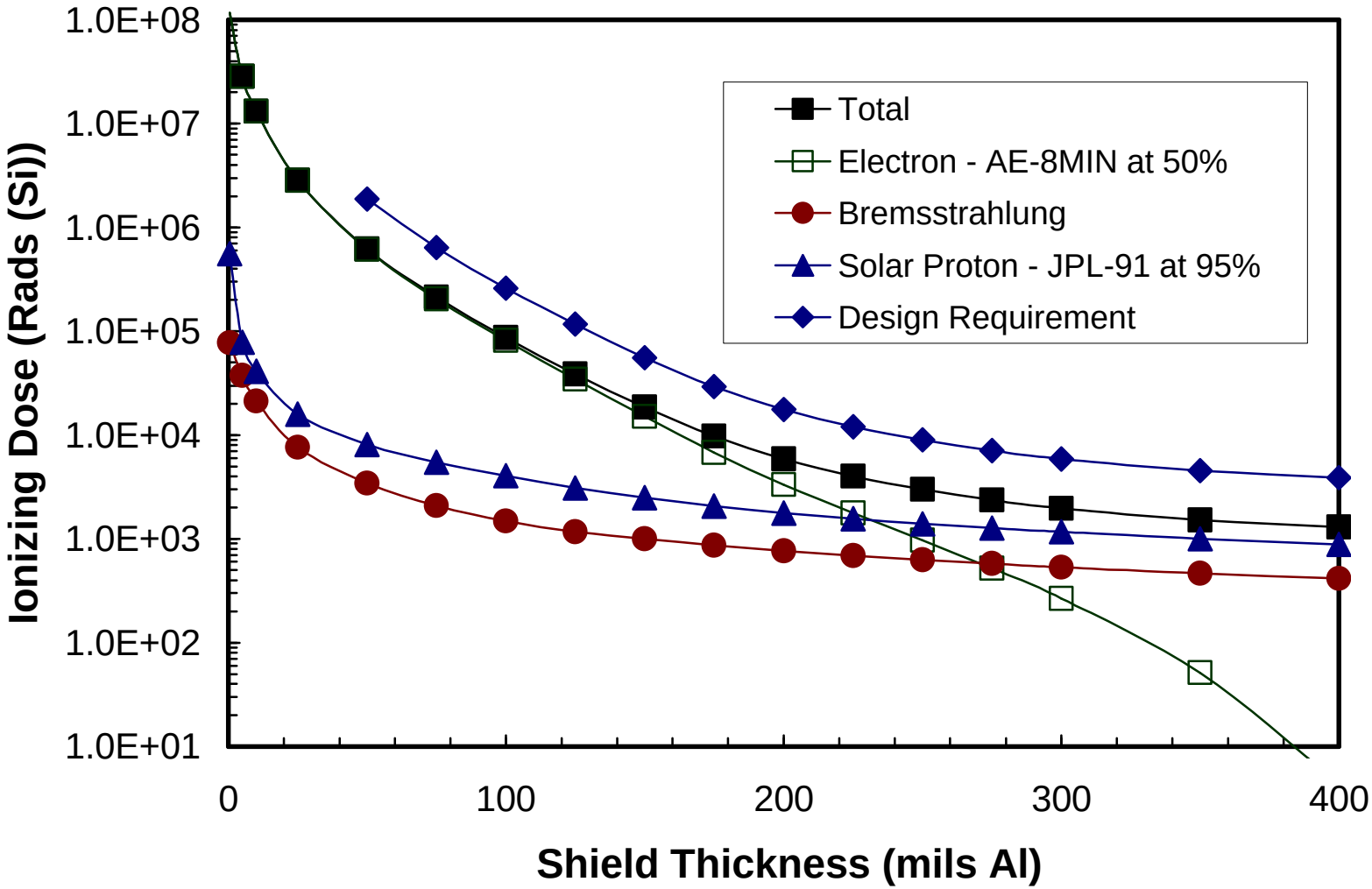
Radiation Requirements (1 of 2)

- **Particle Radiation**
  - **Sources Include Galactic Cosmic Radiation, Geo-Magnetically Trapped Particle Radiation, and Solar Particle Event Radiation**
  - **Design for Worst Case Solar Activity, 2 ½ Year Mission With Sufficient Design Margins (2X for Uncertainty Plus 50% Design margin)**
- **Total Ionizing Dose**
  - **See Following Dose Depth Curve**
  - **Using Design Margins, Dose Requirement Is 55 Krads for 150 mils Hemisphere of Al**
  - **Linear Bipolar Technologies Evaluated for Enhanced Low Dose Rate Sensitivity (ELDRS)**
  - **Displacement Damage Effects Evaluated for CCDs, Solar Panels, and Optocouplers**

Radiation Requirements (2 of 2)

- **Single Event Effects**
  - **Effects Considered for Galactic Cosmic Ray Environment and Worst Case Solar Particle Events**
  - **Single Event Induced Failures (Burnout, Latchup, Gate Rupture, and Secondary Breakdown)**
    - **Parts With Susceptibility >80 MeV cm^2/mg Okay**
    - **Parts With Susceptibility >40 MeV and <80 MeV to Be Reviewed**
    - **Parts With Susceptibility <40 MeV Not Allowed**
  - **Single Event Induced Non-Destructive Failures**
    - **Submitted for Review**
  - **Single Event Upsets**
    - **Allowable But Must be Reviewed**
    - **Cannot Propagate to System Level or Impact Mission Performance**

Dose Versus Depth for 2-p Shield



Launch Vehicle Requirements

- **Launch Vehicle Is a Delta 2425-10**
- **Vibration Analysis Will Determine Specific Vibration Environment for Each Subsystem**
- **Launch Environments (More Detail in Launch Vehicle Presentation):**
  - **Acoustics: 139.9 dB OASPL**
  - **Shock:**

100 Hz	40 g
1500 Hz	4100 g
3000 Hz	4100 g

  - **Thermal: Acoustic Blanket Surface = 65°C to 70°C During Ascent**
    Fairing Separation = 1135 W/m^2
  - **Limit Loads:**

	Liftoff/Transonic	MECO
Lateral	±3 – 3.5 g	±0.1 g
Axial	+2.8/-0.2 g	7.6 ±0.6 g

  - **Sunusoidal Vibration:**

	Frequency	Maximum Flight Levels
Axial	5 – 6.2 Hz	1.27 cm (Double Amplitude)
	6.2 – 100 Hz	1.0 (Zero to Peak)
Lateral	5 – 100 Hz	0.7 g (Zero to Peak)

EMC/EMI Requirements

- Requirements to Be Documented in EMC/EMI Test Plan
- Driven by:
  - Spacecraft Receiver Interference
    - NRL RF Group to Specify
  - Instrument Sensitivities
    - Lockheed to Specify Frequencies and RF Power Levels
  - Range Requirements
    - Dictated by Range Radar
- Subsystem/System Testing Must Verify That Conducted and Radiated Emissions Do Not Exceed Specified Levels (CE0/RE0 Requirements)
- Subsystem/System Testing Must Verify That They Are Not Susceptible to Conducted and Radiated Emissions (CS0/RS0 Requirements)

Documentation Deliverables

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Documentation Deliverables (1 of 3)

Document Name	Number	SRR	PDR	CDR	PER	PSR	FRR	Assignee
Science Requirements Document	NCST-D-FM001	Final						K. Seidelmann
Mission Requirements Document	NCST-D-FM002	Final						M. Johnson
FAME Error Budget	NCST-D-FM003	Final						K. Johnston
Systems Engineering Management Plan (SEMP)	NCST-D-FM004	Prel.	Final					M. Johnson
Product Assurance Plan	NCST-D-FM005	Prel.	Final					B. Mann
SR&QA Plan	NCST-D-FM006	Prel.	Final					B. Mann
Contamination Control Plan	NCST-D-FM007	Prel.	Rev.	Final				R. Mader
Configuration Management Plan	NCST-D-FM008	Prel.	Final					M. Johnson
Software Management Plan - Flight	NCST-SDP-FM001	Prel.	Final					M. Hayden
Software Management Plan – Ground	NCST-SDP-FM002	Prel.	Final					J. Johnson
Design, Loads, and Analysis Plan	NCST-D-FM017	Prel.	Final					R. Mader
Safety Documents								
Preliminary Safety Assessment	NCST-D-FM009	Prel.	Final					R. Contillo
System Safety Implementation Plan (SSIP)	NCST-D-FM010				Final			R. Contillo
Ground Operations Procedures (30 days before PER)					Final			P. Klein R. Contillo
Safety Data Package						Final		R. Contillo
Launch Site Data Plan						Final		R. Contillo

Documentation Deliverables (2 of 3)

Document Name	Number	SRR	PDR	CDR	PER	PSR	FRR	Assignee
Space Segment Documents								
Instrument								
Instrument Design Specification		Prel.	Final					S. Horner
Instrument to S/C ICD	NSCT-ICD-FM001	Prel.	Final					R. Mader, C. Garner
Instrument Subsystem and Component Specifications	LMMS Document Numbers		Prel.	Final				LMMS
Spacecraft								
S/C Design Specification	NCST-S-FM001	Prel.	Final					R. Mader, C. Garner
S/C Component Specifications	NCST-S-FM002 Through NCST-S-FM00*n*		Prel.	Final				NRL
System Test Plan	NCST-TP-FM001			Final				R. Mader, C. Garner
Verification Matrix				Final				M. Ream
Environmental Test Matrix				Final				M. Ream
Verification Procedures				Final				NRL
Integration and Test Procedures				Final				NRL
Software Document								
Software Requirements Document – Ground	NCST-SRS-FM001	Prel.	Final					J. Johnson
Software requirements Document – Flight	NCST-SRS-FM002	Prel.	Final					M. Hayden

Documentation Deliverables (3 of 3)

Document Name	Number	SRR	PDR	CDR	PER	PSR	FRR	Assignee
Launch Segment Documents								
S/C to L/V ICD	NCST-ICD-FM002		Prel.	Final				R. Mader
Ground Segment Documents								
Ground Segment Description Document	NCST-D-FM016	Prel.	Final					P. Klein
Space to Ground ICD	NCST-ICD-FM003		Prel.	Final				P. Klein
Supporting Documents								
Failure Mode and Effects Analysis (FMEA)	NCST-D-FM011			Final				M. Johnson
Preliminary EEE Parts List	NCST-D-FM012		Final					M. Johnson
Preliminary Materials List	NCST-D-FM013		Final					R. Mader
Orbital Debris Report (CDR +60 Days)	NCST-D-FM014			Final				R. Mader
Space Segment Reliability Analysis	NCST-D-FM015			Final				M. Johnson
MO&DA Documents								
Data Analysis Requirements		Prel.	Final					R. Gaume
Flight Operations Plan					Prel.	Final		P. Klein
Software User Guides					Prel.	Final		J. Cleveland
Final B/C/D Technical Report								M. Johnson
Final Phase E Technical Report								K. Johnston